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# A hetero bipolar transistor

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Patent Exam
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The invention relates to a heterobipolar transistor, comprising an emitter which includes a first semiconductor layer made of a first semiconductor material and a second semiconductor layer made of a second semiconductor material, a band gap value of the first semiconductor material being smaller than a band gap value of the second semiconductor material.

Heterobipolar transistors (HBT) have a number of advantages. In particular, their very good frequency behavior has led to increasing usage of hereterobipolar transistors in high frequency circuits such as needed, for example, in mobile radio technology. Switching frequencies obtainable with heterobipolar transistors lie in a range above 100 GHz.

Heterobipolar transistors based on III-V semiconductor technology are used a lot. An emitter of a known n-p-n InP heterobipolar transistor comprises a sequence of adjacent semiconductor layers. A first $n^+$ doped emitter semiconductor layer has a small band gap value. InGaAs is an example of semiconductor material having a low band gap value. One face of the first emitter semiconductor layer is contacted metallically. The next adjacent emitter semiconductor layer is an $n^+$ doped semiconductor layer which has a greater band gap value. For example, InP and InAlAs are materials which have a high band gap value. The next $n^-$ doped emitter semiconductor layer made of the same semiconductor material with a great band gap value is located adjacent to a $p^+$ doped base layer having a small band gap value. Often InGaAs is used as the base layer material.

At the emitter-semiconductor interfaces InP/InGaAs and InAlAs/InGaAs, respectively, a discontinuity in the conduction band occurs, forming a thin, high barrier to the electrons. The conduction band electrons must tunnel through this barrier. Such an energy barrier presents an obstacle to the electron flow and thus to